High-impact Los Alamos innovations honored as R&D 100 award finalists

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Inventions solve problems in energy, modeling and simulation, health, materials and engineering

LOS ALAMOS, N.M., Aug. 28, 2018—Ten Los Alamos National Laboratory innovations are finalists for the 2018 R&D 100 Awards, which honor the top 100 proven technological advances of the past year as determined by a panel selected by *R&D Magazine*. The finalists, with projects covering energy, modeling and simulation, health, materials, and engineering, demonstrate the continued success of Laboratory researchers in technical innovation for national security science.

“I congratulate the R&D 100 Finalists on their selection,” said John Sarrao, principal associate director of Science, Technology & Engineering at Los Alamos. “Their inventions demonstrate the breadth of scientific creativity and technical achievement in support of the Laboratory’s national security mission. This year’s finalists also exhibit the importance of external partnerships in developing technical solutions to serve the country and enhance the nation’s industrial competitiveness.”

The Los Alamos projects selected as finalists are the following:

- **ACCObeam**: The Acoustic Collimated Beam enables precise, inexpensive monitoring of fractured rock, concrete and metal.
- **Charliecloud:** Lightweight container software enables software “containers” on high-performance computers.
- **Grand Unified File Index (GUFI)**: Provides the fastest software for searching metadata at the scale used by supercomputer and enterprise centers.
- **Insight**: Delivers automated sample-to-result analysis of an individual’s gut microbiome.
- **Lighthouse Directional Radiation Detectors**: Precisely determines the location, amount and movement of a radioactive source in the presence of multiple sources.
- **Long-Range Wireless Sensor Network**: This turnkey, low-power sensor network enables data collection and transmission in rugged, remote outdoor environments.
- **Rad-Hard Single-Board Computer for Space**: Lightweight radiation-hardened computer for satellites and other space applications.
- **Silicon Strip Cosmic Muon Detectors for Homeland Security**: The slim profile of these detectors enables stealthy deployment to detect shielded nuclear materials.

- **Universal Bacterial Sensor**: The sensor mimics biological recognition of bacterial pathogens to enable the detection of bacterial infections even before the onset of symptoms.
- **Video-Based Dynamic Measurement & Analysis (ViDeoMAgic)** uses video of a vibrating structure and extracts high-spatial-resolution structural vibration and dynamics information to measure the dynamic response and analyze the health of civil, mechanical and aerospace structures.

“Los Alamos National Laboratory has a well-established track record in innovations that have been recognized as finalists in the R&D 100 Awards,” said Tony Redondo, division leader of the Laboratory’s Feynman Center for Innovation. “This year is no exception as the nine projects that were submitted by the Laboratory, as well as a project submitted in collaboration with other partners, have been selected as finalists. All of these submissions have significant potential for commercialization and some of them are already on their way to realizing that potential.”

This year’s R&D 100 winners will be announced by the magazine on November 16.

About the Finalists

ACCObeam: Acoustic Collimated Beam
The Acoustic Collimated Beam is a novel high-power, low-frequency, collimated sound beam that penetrates materials deeply and in high resolution. The invention provides precise, inexpensive imaging of fractured rock, cement, mud and metal for borehole imaging, explosives threat evaluation and other applications. Cristian Pantea led the team of Dipen Sinha and Vamshi Chillara.

Charliecloud: Lightweight Container Software
Charliecloud enables software containers – packages of custom code, software or software environments – on high performance computers. The invention achieves portability, consistency, usability and security in 1,000 lines of open-source code. It runs on existing high performance computing systems with zero configuration, servers or extra processes. Reid Priedhorsky and Tim Randles led the team of Michael Jennings, J. Lowell Wofford, Jordan Ogas of Los Alamos and collaborators from the University of Bonn and Wellcome Trust Sanger Institute.

GUFI: Grand Unified File Index
The Grand Unified File Index is the fastest software for searching metadata at the scale used by supercomputer and enterprise datacenters. This open-source software allows simultaneous secure queries of ultrascale metadata by multiple users and system administrators. Users can search billions of files in the file system trees and receive query results in seconds, without sacrificing the performance of the file system itself or impacting security. Gary Grider led the team of David Bonnie, Jeff Inman, Dominic Manno and Wendy Poole.

Insight: Sample-to-Result Microbiome Analysis
Insight provides automated metatranscriptomic sequencing and bioinformatic analysis of an individual’s gut microbiome with the goal of improving health. In addition to identifying and quantifying the microbes, Insight determines what microbes are currently active in the gut. Viome, Inc. has combined this technology with a simple in-home collection kit and smartphone app to provide personalized wellness and nutrition recommendations.

Los Alamos submitted the joint entry with Viome, Inc. based on technology that Viome licensed from the Lab. Jason Gans and Patrick Chain led the team of Andrew Hatch, Po-E Li and Chien-Chi Lo with collaborator Momchilo Vuyisich of Viome.

Lighthouse Directional Radiation Detectors

The detectors precisely determine the location, amount and movement of a radioactive source in the presence of multiple sources. Gamma, fast-neutron and thermal-neutron detectors are small, lightweight, portable, high resolution and fast. Applications include environmental and geological surveys, emergency response, materials accountability and control, and situational awareness.

LANL submitted the joint entry with Questa Instruments LLC, Phoenix International Holdings Inc., Sexton Corp. L. Jonathan Dowell and Dale Talbott led the team of Rick Rasmussen, Rick Rothrock, Sam Salazar, Theresa Cutler, Mark Wald-Hopkins, Kris Hyatt, Don Hyatt, Larry Bronisz, James Thompson, Chris Chen, David Fontaine, Adam Kingsley, Thomas Barks,, Damien Milazzo, James Hemsing, Gary Sundby and David Allen. The team included collaborators from the U.S. Army; Quaesta Instruments, LLC; Phoenix International Holdings, Inc.; and Sexton Corporation.

Long-range Wireless Sensor Network

The Long-range Wireless Sensor Network grew out of the Lab's decades of experience developing satellite components for the harsh space environment. The turnkey low-power sensor network is self-forming and self-healing and scales to hundreds of nodes for unattended operation. It can affordably collect, process and transmit data over long distances (19 kilometers point-to-point) in rugged, extreme and remote outdoor environments.

LANL submitted the joint entry with West Virginia University. Janette Frigo led the team of Tracy Gambill, James Krone, Hudson Ayers, Shawn Hinzey, Kari Sentz, Xiaoguang Yang, Terra Shepherd, Richard Dutch, Louis Borges, Bobby Quintana, Ryan Hemphill, Michael Cai, Sanna Sevanto, Cathy Wilson, Joel Rowland, Thom Rahn, Kevin McCabe, Don Enemark, Michael Proicou, David Guenther, Stephen Judd, Armand Groffman, Alexandra Saari, Steven Veenis, Allison Chan, Bobbie Rappe, Tom Dufresne and collaborator Vinod Kulathumani of West Virginia University.

Rad-Hard Single-Board Computer for Space

The lightweight, low-cost single board computer has radiation-hardened and mechanically-hardened electronics for satellites and other space applications. It is smaller and uses less power than any other space-grade computer currently available. Industry standard MicroTelecommunication Computing Architecture expands compatibility and interoperability. The invention leverages the Lab's more than 50 years designing instruments for satellites and deep space missions.

Robert Merl and Paul Graham led the team of Zachary Baker, Justin Tripp, John Michel and Richard Dutch.

Silicon Strip Cosmic Muon Detectors for Homeland Security

Naturally occurring cosmic particles called muons "rain down" from the atmosphere and scatter significantly when they interact with high-atomic-number materials. Muon trackers use the scattering trajectory signature to detect shielded nuclear materials, explosives, and other items of interest. The slim profile of silicon strip muon detectors provides versatility and enables stealthy deployment into walls, ceilings and portable devices.

Nevada National Security Site Mission Support and Test Services LLC submitted the joint entry with Fermi National Accelerator Laboratory and Los Alamos National Laboratory. The Los Alamos team included Chris Morris, J. Matthew Durham and Elena Guardincerri.

Universal Bacterial Sensor

The human immune system inspired the development of the Universal Bacterial Sensor — a unique technology that mimics biological recognition of bacterial pathogens. Like the immune system, the sensor recognizes *all bacterial infections* as early as before the onset of symptoms. The method uses only a small volume of sample and requires no prior knowledge of what the bacteria might be. It is inexpensive, field-ready, can be performed by a nonexpert and provides reliable answers within 30 minutes.

Harshini Mukundan led the team of Basil Swanson, Aaron Anderson, Jessica Kubicek-Sutherland, Ramamurthy Sakamuri and Loreen Stromberg.

ViDeoMAgic: Video-Based Dynamic Measurement & Analysis

ViDeoMAgic analyzes digital video of a vibrating structure to extract structural-dynamics response information in high spatial resolution. Unsupervised machine learning algorithms then analyze those dynamic responses and extract the structure's dynamics properties (resonant frequencies, damping & mode shapes) from the video data That data, in turn, can be used to assess the system's health (with respect to damage and defects). High fidelity, *in situ* damage detection of civil, mechanical, and aerospace structures enables identification and remedy of incipient damage *before* it reaches the critical level.

Yongchao Yang led the team of David Mascareñas, Charles Dorn, Charles Farrar and Garrett Kenyon.

The R&D 100 Awards

The prestigious "Oscars of Invention" honor the latest and best innovations and identify the top technology products of the past year. The R&D 100 Awards span industry, academia and government-sponsored research organizations. Since 1978 Los Alamos has won 145 of the prestigious R&D 100 Awards. The Laboratory's discoveries, developments, advancements and inventions make the world a better and safer place, bolster national security and enhance national competitiveness.

Read more about the Laboratory's past R&D 100 Awards.

Captions for images below:

- *Video-Based Dynamic Measurement & Analysis, with David Mascarenas and Yongchao Yang*
- *Paul Graham and Rob Merl with the Radiation-hardened Single Board Computer for space.*
- *Cristian Pantea and Dipen Sinha with the Acoustic Collimated Beam (ACCObeam)*